

BONDING AND CRYSTALS

1. Use simple structure and bonding models to account for each of the following.
 - (a) The bond length between the two carbon atoms is shorter in C_2H_4 than in C_2H_6 .
 - (b) The H-N-H bond angle is 107.5° , in NH_3 .
 - (c) The bond lengths in SO_3 are all identical and are shorter than a sulfur-oxygen single bond.
 - (d) The I_3^- ion is linear.
 - (e) Xenon has a higher boiling point than neon has.
 - (f) Solid copper is an excellent conductor of electricity, but solid copper chloride is not.
 - (g) SiO_2 melts at a very high temperature, while CO_2 is a gas at room temperature, even though Si and C are in the same chemical family.
 - (h) Molecules of NF_3 are polar, but those of BF_3 are not.
 - (i) $SbCl_3$ has measurable dipole moment, whereas $SbCl_5$ does not.
 - (j) The normal boiling point of CCl_4 is $77^\circ C$, whereas that of CBr_4 is $190^\circ C$.
 - (k) $NaI(s)$ is very soluble in water, whereas $I_2(s)$ has a solubility of only 0.03 gram per 100 grams of water.
 - (l) The lattice energy of $CaO(s)$ is -3,460 kilojoules per mole; the lattice energy for $K_2O(s)$ is -2,240 kilojoules per mole. Account for this difference.

	Ionization Energy (kJ/mol)	
	First	Second
K	419	3,050
Ca	590	1,140

- (m) Account for the difference between first and second ionization energies.
 - (n) The SO_2 molecule has a dipole moment, whereas the CO_2 molecule has no dipole moment. Include the Lewis (electron-dot) structures in your explanation.
 - (o) Halides of cobalt(II) are colored, whereas halides of zinc(II) are colorless.
 - (p) At ordinary conditions, HF (normal boiling point = $20^\circ C$) is a liquid, whereas HCl (normal boiling point = $-114^\circ C$) is a gas.
 - (q) For sulfur, the fluorides SF_2 , SF_4 , and SF_6 are known to exist, whereas for oxygen only OF_2 is known to exist.
 - (r) MgO melts at a much higher temperature ($2,852^\circ C$) than NaF ($993^\circ C$)
2. Consider the following melting points in degrees Celsius:

<u>Alkali metals</u>		<u>Halogens</u>	
Li	181°	F_2	-119°
Na	98°	Cl_2	-101°
K	63°	Br_2	-7°
Rb	39°	I_2	$+104^\circ$
Cs	29°		

- (a) Account for the trend in the melting points of the alkali metals.
 - (b) Account for the trend in the melting points of the halogens.
 - (c) What is the expected trend in the melting points of the compounds LiF, NaCl, KBr, and CsI? Explain this trend using bonding principles.